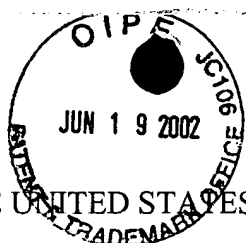


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#6 D.J. 1-02  
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

*Priority Papers*

In re Application of: )  
Duncan Boniface )  
Serial No.: 10/081,609 )  
Filed: February 20, 2002 )  
For: LOUDSPEAKER POLE PIECE )  
AND LOUDSPEAKER ASSEMBLY )  
\_\_\_\_\_ )

June 13, 2002

2643

Los Angeles, California 90067

CLAIM TO PRIORITY UNDER 35 USC 119

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Technology Center 2600

Honorable Commissioner  
of Patents and Trademarks  
Washington, D.C. 20231

Sir:

The benefit of the filing date of the following prior foreign application is hereby requested  
for the above identified application, and the priority provided in 35 USC 119 is hereby claimed:

British Patent Application No. 0104113.6

Filed: February 20, 2001

In support of this claim, the requisite certified copy of said original foreign application is  
filed herewith.

It is requested that the file of this application be marked to indicate that the applicant(s)  
have complied with the requirements of 35 USC 119, and that the Patent and Trademark Office  
kindly acknowledge receipt of these documents.

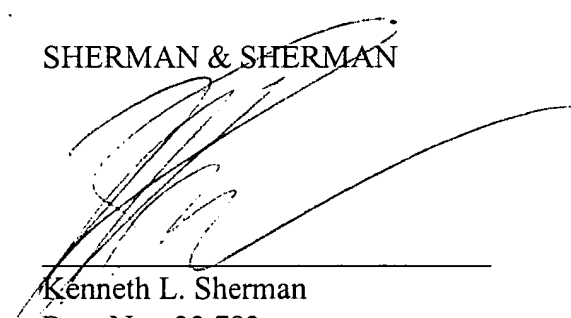
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In the event any fees are due with respect to this paper, please charge our Deposit Account

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Respectfully submitted,

SHERMAN & SHERMAN

  
\_\_\_\_\_  
Kenneth L. Sherman

Reg. No.: 33,783

SHERMAN & SHERMAN

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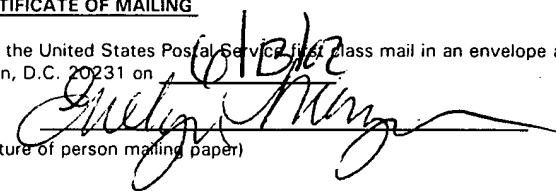
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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein together with the Statement of inventorship and of right to grant of a Patent (Form 7/77), which was subsequently filed.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Dated 21 May 2002

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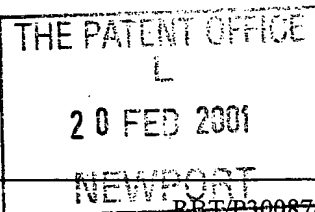
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**Statement of inventorship and of  
right to grant of a patent**



The Patent Office

Cardiff Road  
Newport  
Gwent NP10 8QQ

1. Your reference

RBT/P300874GB

2. Patent application number  
(if you know it)

**0104113.6**

3. Full name of the or of each applicant

KH Technology Corporation

4. Title of the invention

Loudspeaker Pole Pieces

5. State how the applicant(s) derived the right  
from the inventor(s) to be granted a patent

By virtue of employment

6. How many, if any, additional Patents Forms  
7/77 are attached to this form?  
(See note (c))

1

7.

I/We believe that the person(s) named over the page (and on  
any extra copies of this form) is/are the inventor(s) of the invention  
which the above patent application relates to

Signature

Date

*W. P. Thompson & Co*

19 February 2001

**W. P. THOMPSON & Co.**

8. Name and daytime telephone number of  
person to contact in the United Kingdom

Roger B Thomson  
01462 682139

**Notes**

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- b) Write the answers in capital letters using black ink or you may type them.
- c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.
- d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.
- e) Once you have filled in the form you must remember to sign and date it.

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

Duncan Boniface  
c/o Celestion International Limited  
Foxhall Road  
Ipswich  
Suffolk  
IP3 8JP

05046191001

Patents ADP number (if you know it):

Patents ADP number (if you know it):

**Reminder**

Have you signed the form?

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Patents Act 1977  
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The  
Patent  
Office

20 FEB 2001

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P01/7700 0.00-0104113.6

The Patent Office

Cardiff Road  
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Gwent NP10 8QQ

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

1.	Your reference	RBT/P300874GB						
2.	Patent application number (The Patent Office will fill in this part)	<b>0104113.6</b>						
3.	Full name, address and postcode of the or of each applicant ( <i>underline all surnames</i> )	KH TECHNOLOGY CORPORATION Floor 2, Zephyr House Mary Street George Town Grand Cayman Cayman Islands British West Indies						
	Patents ADP number ( <i>if you know it</i> )							
	If the applicant is a corporate body, give the country/state of its incorporation	Cayman Islands						
4.	Title of the invention	Loudspeaker Pole Pieces						
5.	Name of your agent ( <i>if you have one</i> )	W. P. Thompson & Co.						
	"Address for service" in the United Kingdom to which all correspondence should be sent ( <i>including the postcode</i> )	Eastcheap House Central Approach Letchworth Herts SG6 3DS						
	Patents ADP number ( <i>if you know it</i> )	158003						
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and ( <i>if you know it</i> ) the or each application number	<table border="0"> <tr> <td style="text-align: center;">Country</td> <td style="text-align: center;">Priority application number (<i>if you know it</i>)</td> <td style="text-align: center;">Date of filing (<i>Day/month/year</i>)</td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </table>	Country	Priority application number ( <i>if you know it</i> )	Date of filing ( <i>Day/month/year</i> )			
Country	Priority application number ( <i>if you know it</i> )	Date of filing ( <i>Day/month/year</i> )						
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	<table border="0"> <tr> <td style="text-align: center;">Number of earlier application</td> <td style="text-align: center;">Date of filing (<i>Day/month/year</i>)</td> </tr> <tr> <td> </td> <td> </td> </tr> </table>	Number of earlier application	Date of filing ( <i>Day/month/year</i> )				
Number of earlier application	Date of filing ( <i>Day/month/year</i> )							
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? ( <i>Answer 'yes' if:</i> a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))							
	Yes							

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## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

Claims

Abstract

Drawing(s)

50  
2  
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10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (Please specify)

2  
1

11.

We request the grant of a patent on the basis of this application

Signature

W. P. Thompson & Co.

W. P. Thompson & Co.

Date

19 February 2001

12.

Name and daytime telephone number of person to contact in the United Kingdom

Roger B Thomson  
01462 682139

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### Notes

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Patents Form 1/77

LOUDSPEAKER POLE PIECES

This invention relates generally to loudspeakers, and more particularly to the cooling of loudspeakers having a permanent magnet and a voice coil which causes the vibration  
5 of a diaphragm.

A continuing problem in the design of such loudspeakers has been the dissipation of the heat which is generated in the voice coil, and which if not dissipated leads to degraded performance and possibly destruction of the voice coil.

10 Various methods have been used in the pursuit of a solution to this problem. For example, it is known to circulate cooling air over the coil by means of blowers or by using the movements of the diaphragm to force air over the coil. This is generally unsatisfactory. In US-A-4378471  
15 there is described a horn speaker where the pole piece is provided with a plurality of linear grooves in its front surface. However, the purpose of these is not to dissipate the heat of the coil but to suppress the generation of heat in the pole by suppressing eddy currents. In US-A-5042072  
20 there is described a self-cooled loudspeaker in which the central pole piece is cup-shaped and has a number of axially extending grooves or channels in its outer surface to enable air to pass over the adjacent voice coil. A development of this is described in US-A-5497428 where again peripheral  
25 channels are provided but where the centre of the pole piece is also apertured. In US-A-5909015 there is described a self-cooling loudspeaker in which the central pole piece is annular and cooling air is drawn in radially to pass over the coil. In each of these three last-mentioned documents the design is  
30 intended to encourage air actually to pass over and through the coil and to remove the heat at source.

It is an object of the present invention to address the problem from a different perspective and to use the pole piece as the medium for improved cooling of the voice coil.

This object is achieved by regarding the pole piece as  
5 a heat sink and then arranging for the heat absorbed by the pole piece to be dissipated from it.

It is known in moving coil loudspeakers of open dust cap design to use a pole piece in the form of a solid cylinder which sits within the coil and its former, and which closes  
10 off the speaker assembly to the rear. Here, heat passes from the coil to the pole piece, but heat dissipation can only take place from the flat circular front face of the pole piece, which is of relatively small surface area, resulting in very little heat dissipation.

15 In another conventional moving coil loudspeaker, with a closed, non-porous dust cap, the central pole piece is an annulus with a venting hole through its centre. Here, there is a convection movement of air from the apertured centre of the pole piece rearwards, towards the inside of the cabinet,  
20 where the hot air is trapped.

In neither of these conventional designs in which the pole piece acts as a heat sink, is there adequate cooling.

It is therefore an object of the present invention, using the pole piece as a heat sink, to improve the dissipation of  
25 heat from it. This is achieved by the use of a pole piece of an improved shape and configuration.

In accordance with the invention there is provided a pole piece for a loudspeaker assembly, which is of generally cylindrical form about a longitudinal axis, with a blind  
30 recess in one end face, and with a plurality of heat-dissipating ribs around the circumferential wall of the

recess.

The ribs are preferably aligned with the longitudinal axis of the pole piece. They are preferably equispaced around the wall of the recess.

- 5 In a preferred embodiment, the circumferential mark/space ratio of the ribs to the gaps therebetween is approximately 1:1.

Desirably, the blind recess is tapered, decreasing in diameter away from said one end face of the pole piece. The  
10 ribs preferably taper in conformity with the taper of the recess. This taper enables the pole piece to be manufactured as a forging, thus requiring no additional component cost and with no further operations or post-treatment or working required.

- 15 Preferably, each rib is of trapezoidal shape in horizontal cross-section through the pole piece, with a sloping radially inner face and sloping side faces.

Also in accordance with the invention there is provided a loudspeaker assembly comprising a housing, a diaphragm  
20 supported by the housing, a moving coil coupled to the diaphragm, a permanent magnet encircling the coil, and a pole piece in accordance with the invention positioned within the coil and having its said one end face in communication with the ambient atmosphere.

- 25 Preferably, the ribbed portion of the pole piece is substantially co-extensive with the coil.

By modifying the shape of the pole piece, heat dissipation is increased. A number of benefits and advantages arise from this:

- 30 • There is increased heat dissipation from the loudspeaker motor assembly, leading to improved

power handling, greater reliability, reduced thermal compression and reduced distortion.

- There is more even heat dissipation over the length of the coil, giving improved linearity and therefore reducing distortion.

- There is a reduced volume of steel required for the pole piece, leading to a reduction in weight for the assembly and also reduced cost.

In order that the invention may be more fully understood, one presently preferred embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Fig. 1 is a schematic horizontal cross-section through a loudspeaker assembly in accordance with the invention and incorporating a pole piece in accordance with the invention;

Fig. 2 is a plan view of the pole piece of Fig. 1, showing more clearly the arrangement of ribs; and,

Fig. 3 is a cross-sectional view through the pole piece, taken along the line III-III in Fig. 2.

Fig. 1 shows a loudspeaker assembly 10 comprising a housing or chassis 12 from which a cone 14 is suspended by a front suspension 16 and a rear suspension 18. The front suspension 16 is mounted to the housing by an annular gasket 20. Within the cone 14 is a dust cap 22 which is porous, i.e. permeable to air.

Secured by screws to the back of the housing 12 is a front plate 24 of the magnet assembly. Rearwardly of the front plate is an annular magnet 26, to which is fixed a pole piece or yoke 28. The pole piece 28 has a central boss 30 which extends axially through the magnet and front plate, defining an annular voice coil gap around the pole piece.

Within this gap is located a voice coil 32 carried by a cylindrical former secured to the cone 14.

The pole piece boss 30 has a blind recess 34 in its axial end face which faces the dust cap 22. The internal wall of the recess 34 is provided with a plurality of projecting ribs or fins 36 which extend the full depth of the recess. Eight ribs 36 are shown in Fig. 2, but a greater or lesser number could be provided. The ribs 36 are preferably equispaced, as shown. In the illustrated embodiment, the mark-to-space ratio of the ribs to the grooves between them is approximately 1 to 1. The recess 34 is slightly tapered, as are the ribs 36. This enables the pole piece to be made by a forging process. Consequently, each rib 36 has a sloping radially inner surface 38 and sloping sides 40. In horizontal section, each rib 36 therefore has a trapezoidal shape.

The depth of the recess 34 is a matter of choice, although a depth equal to about half the axial length of the pole piece 28 is generally suitable. What is important is that the depth of the recess 34 should be sufficient so that it at least spans the path of travel of the voice coil 32. In other words, no matter in what position the voice coil 32 is located, its whole axial length should be opposed, across the voice coil gap, by the ribbed wall of the pole piece.

The provision of the ribs 36 dramatically increases the surface area available for heat dissipation. Air can flow in to the centre of the pole piece, enabling cooling close to the coil over the whole of the path of travel of the coil. By this means one avoids the creation of steep temperature gradients along the axial length of the coil. In the conventional pole piece designs referred to above, where heat is only dissipated from the front or rear of the pole piece,

i.e. some way from the coil position, one can get steep temperature gradients along the coil, which reduces the linearity of the cone movement.

In use, hot air within the pole piece escapes by convection and by radiation through the dust cap 22, thereby drawing in cool air to continue the cooling process. The hot air escapes into the ambient atmosphere, not into the loudspeaker cabinet. This ensures a relatively constant dissipation of heat.

10 It is to be understood that the arrangement and configuration of ribs shown in the illustrated embodiment is by way of example only. The number, shape and orientation of the ribs or fins can be varied from that shown without exceeding the scope of the invention.



## CLAIMS:

1. A pole piece for a loudspeaker assembly, which is of generally cylindrical form about a longitudinal axis, with a blind recess in one end face, and with a plurality of heat-dissipating ribs around the circumferential wall of the recess.
2. A pole piece as claimed in claim 1, in which the ribs are aligned with the longitudinal axis of the pole piece.
3. A pole piece as claimed in claim 1 or 2, in which the ribs are equispaced around the wall of the recess.
4. A pole piece as claimed in any preceding claim, in which the circumferential mark: space ratio of the ribs to the gaps therebetween is approximately 1:1.
5. A pole piece as claimed in any preceding claim, in which the blind hole is tapered, decreasing in diameter away from said one end face of the pole piece.
6. A pole piece as claimed in claim 5, in which the ribs taper in conformity with the taper of the recess.
7. A pole piece as claimed in claim 5 or 6, in which each rib is of trapezoidal shape in horizontal cross-section through the pole piece, with a sloping radially inner face and sloping side faces.
8. A pole piece as claimed in any preceding claim, in which the depth of the recess is approximately half the longitudinal length of the pole piece.
9. A pole piece as claimed in any preceding claim, which is made as a forging.
10. A loudspeaker assembly comprising a housing, a diaphragm supported by a housing, a moving coil coupled to the diaphragm, a permanent magnet encircling the coil, and a pole piece as claimed in any of claims 1 to 9 positioned within the

coil and having its said one end face in communication with the ambient atmosphere.

11. A loudspeaker assembly as claimed in claim 10, in which the ribbed portion of the pole piece is substantially co-extensive with the coil.

ABSTRACTLOUDSPEAKER POLE PIECES

A generally cylindrical pole piece (28) for a moving coil loudspeaker has a blind recess (34) in the axial end face 5 which faces an air-permeable dust cap. The recess is lined with a plurality of spaced ribs or fins (36) to increase the surface area available for heat dissipation. The recess and ribs are preferably tapered, to enable the pole piece to be made as a forging.

10 (Fig. 2)

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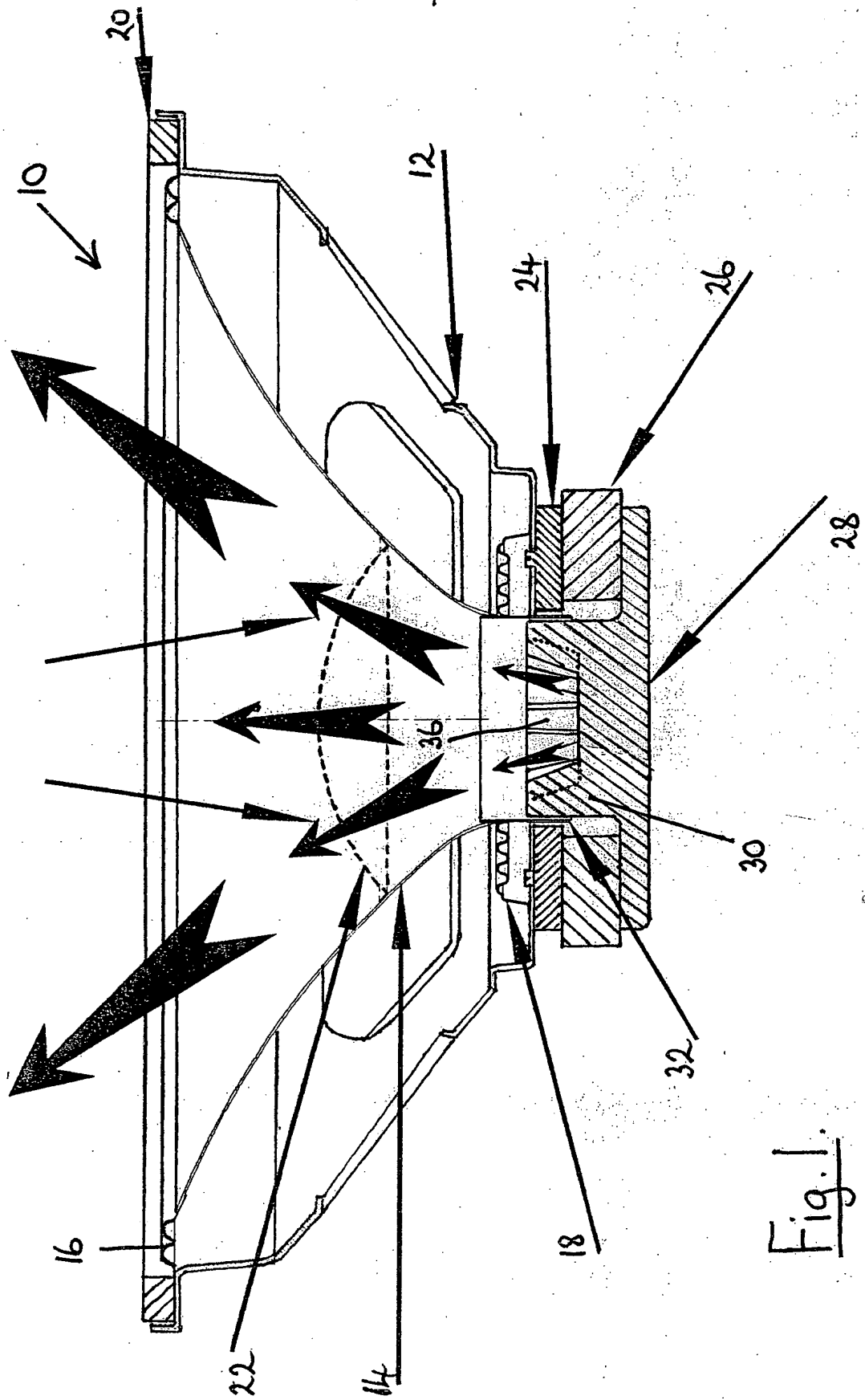


Fig. 1.

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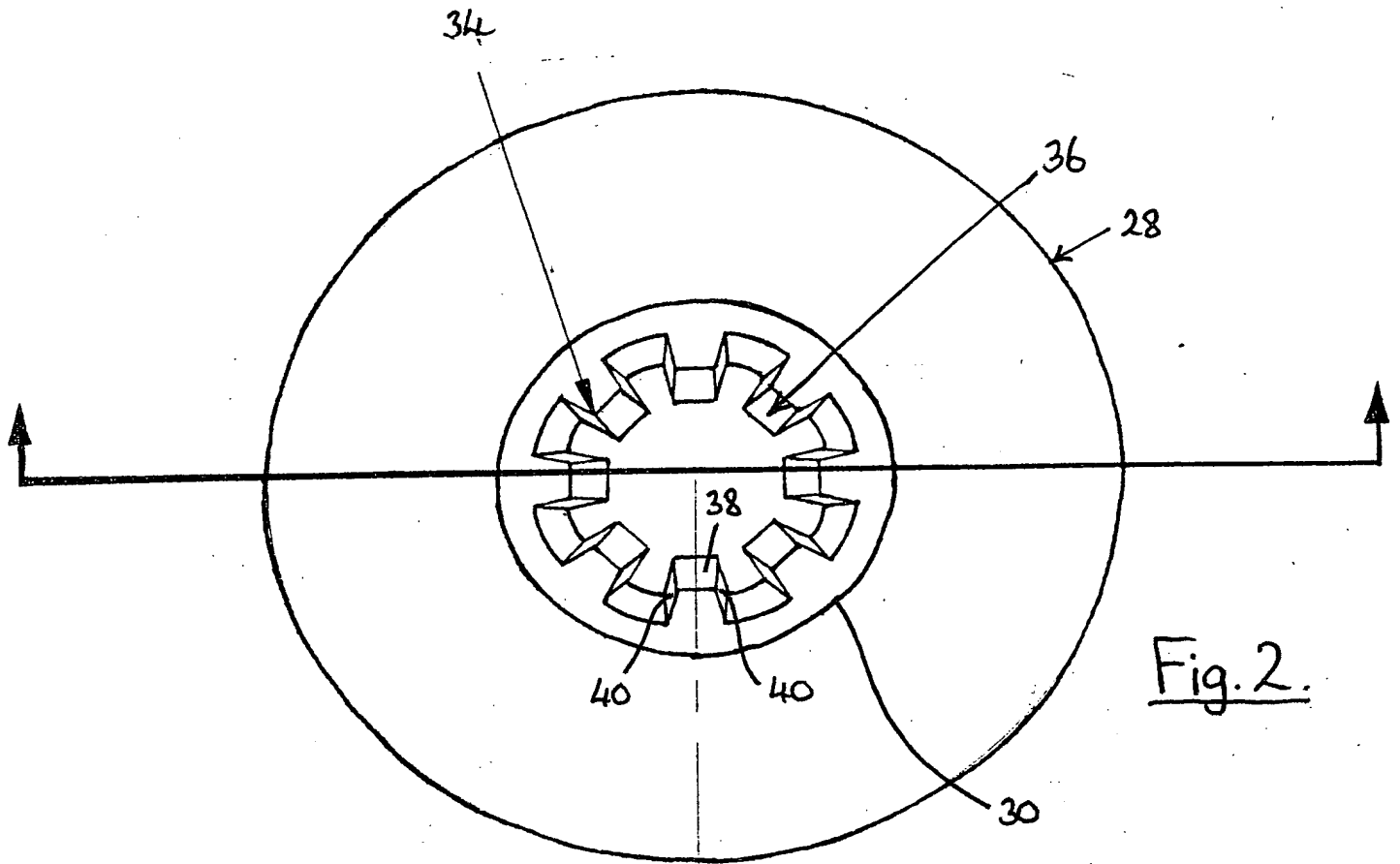


Fig. 2.

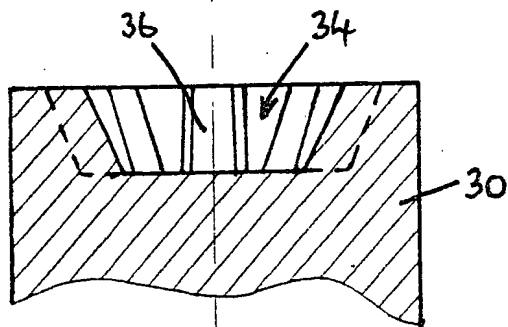


Fig. 3.

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